	Presenter:
	Organization/Date: Orbiter/06-28-01

BACKUP INFORMATION

	Presenter:
	Organization/Date: Orbiter/06-28-01

STS-98
IN-FLIGHT ANOMALIES
BACKUP

STS-98-V-01: LH_2 ENGINE 1 PREVALVE (PV4)	Presenter:
	Organization/Date: Orbiter/06-28-01

Observation:

- MPS LH_2 prevalve open indicator B failed off intermittently during ascent and following LH_2 dump

Concern:

- Loss of both open A and B indications during prevalve opening (T-9.5 seconds) prior to SSME start will result in RSLS scrub at T-7 seconds
  - LCC RSLS-01

Discussion:

- Failure history for this valve shows two previous occurrences of dropouts
  - Flow 10 - 0.2 sec dropout
  - Flow 17 - 1.8 and 0.8 sec dropouts
  - Both failures were closed as UAs with the most probable cause attributed to personnel in the area

STS-98-V-01: LH_2 ENGINE 1 PREVALVE (PV4)	Presenter:
	Organization/Date: Orbiter/06-28-01

Actions Taken:

- Post-flight troubleshooting identified an intermittent connection in the wire harness at the connector which mates to the prevalve
- The connector and two associated wire segments have been replaced
- The circuit was successfully retested

Acceptable for STS-104 Flight:

- The faulty OV-104 wire harness was repaired
- OMRS verification is accomplished prior to and during propellant loading
- LCC will allow launch even if 1 of 2 open indicators fails off after prevalve is commanded open for SSME start

STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/06-28-01

Observation:

- During STS-98 entry, both CDR and PLT observed a runway misalignment on their Heads-Up Displays (HUDs)

Concern:

- HUD misalignment could mislead crew at critical time

Discussion:

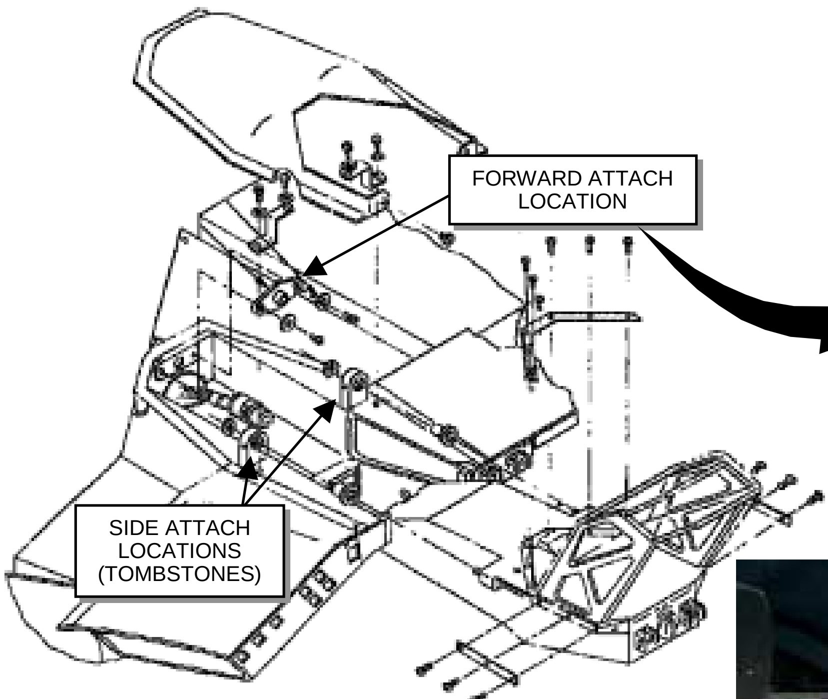
- Review of pilot-point-of-view (PPOV) video and crew debrief from STS-98 revealed the pilot and commander HUDs were misaligned as much as two runway widths during final approach
- Calculations based on altitude and approach angle indicate misalignment on the order 55 minutes of right yaw (16 milliradians or 0.9 degrees)

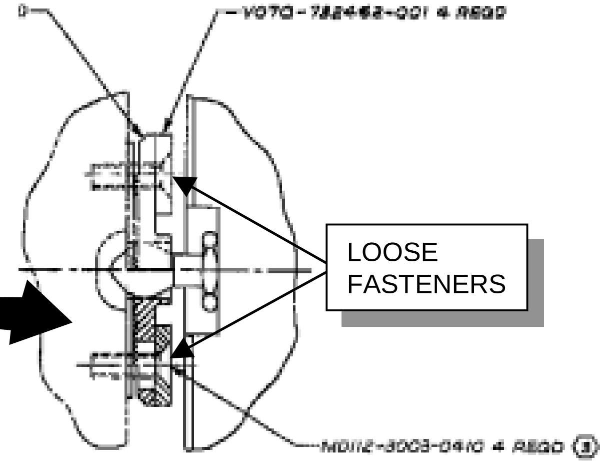
STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT

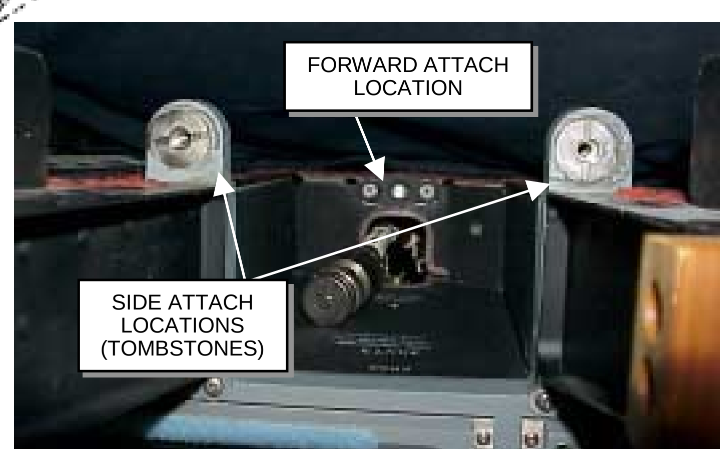
Presenter:

Organization/Date:
Orbiter/06-28-01

HUD Assembly Detail







STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/06-28-01

Actions Taken:

- Review of videos of pilot HUD display on STS-98, STS-101 and STS-106 all show similar misalignment
- Review of OV-104 pre-MEDS and videos of other Orbiters show no misalignment
- Review of MEDS mod verified that HUD installation in conjunction with MEDS is structurally no different than original installation
- Post flight inspection of OV-104 Pilot Display Units (PDUs) disclosed loose front support bracket

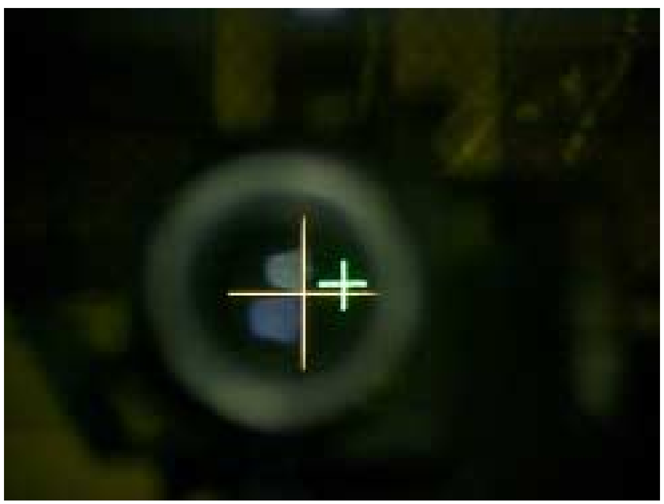
STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT

Presenter:

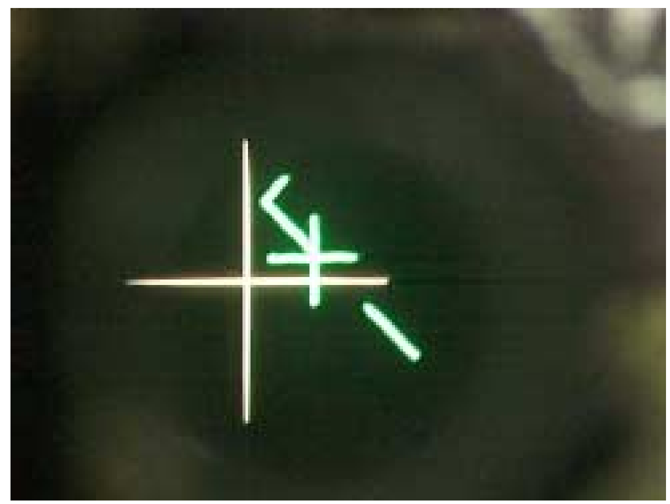
Organization/Date:
Orbiter/06-28-01

Actions Taken:

- HUD optical alignment GSE was installed in OV-104
  - Initial alignment check with retorque of forward attach showed both CDR and PLT HUDs misaligned approximately 34 minutes of right yaw (vs +/- 15 minutes required by specification)



COMMANDER HUD CHECK



PILOT HUD CHECK

STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/06-28-01

Actions Taken (Cont):

- Complete HUD alignment was performed including realignment and potting of side attach "tombstones"
  - Both CDR and PLT were aligned to within 1 min, 30 sec

FINAL COMMANDER HUD ALIGNMENT

FINAL PILOT HUD ALIGNMENT

STS-98-V-02: COMMANDER AND PILOT HUD MISALIGNMENT	Presenter:
	Organization/Date: Orbiter/06-28-01

Risk Assessment:

- The HUD is criticality 1R2 for night landings, 1R3 otherwise
- MEDS or dedicated flight instruments provide everything necessary to safely land the vehicle

Acceptable for STS-104 Flight:

- OV-104 HUDs have been realigned to within 1 minute 30 seconds of centerline
- Vehicle systems redundancy and workarounds exist to accommodate HUD failures

	Presenter:
	Organization/Date: Orbiter/06-28-01

CONFIGURATION CHANGES AND CERTIFICATION BACKUP

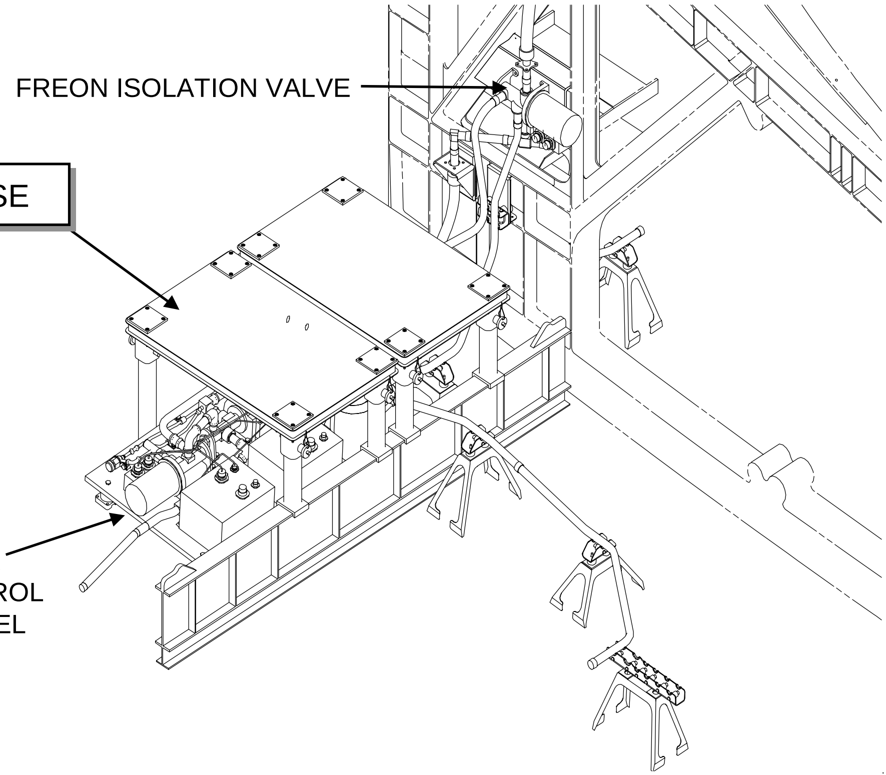
CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

First Flight of MCR 17177 Freon Relief Line Reroute

- GSE developed to protect exposed relief lines for systems which have not yet been modified



CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 17177 Aft Ballast Shim Modification				N/A		• Reduces shim size • Shim interfered with shim ballast box on OV-105 (PR EOTF)
MCR 17177 Freon Coolant Loop Move		X		03-24-610005-OFT (B) 03-24-634480G	5/29/01A	• Original routing of line susceptible to damage during maintenance • Line rerouted
MCR 17990 Payload Bay Door Aft Sealing Surface Redesign		X		130A-02-370004-002G 130-02-770004-002C	12/12/97A	• Shims added to assure minimum air intrusion in the aft
MCR 18209 Condensate Separation/Collection Mod Phase I			X	02-22-621-0008-0007F	11/28/00A	• Phase I installs permanent hardline and QD at the mid-deck floor to separate and collect condensate
			X	04-24-271-0089-1004E	11/16/00A	
		X		01C-23-623200-001C	10/12/00A	

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18755 Starboard Lightweight Tool Stowage Assembly (TSA) Cushion Mission Kit MVO849A			X	05-25-849-660516-001E	5/8/01A	• STS-104 flight unique cushion assembly configuration for starboard LWTSA
MCR 18755 Port Heavyweight Tool Stowage Assembly (TSA) Cushion Mission Kit MVO849A			X	05-25-849-660516-001E	5/8/01A	• STS-104 flight unique cushion assembly configuration for Port HWTSA
MCR 18755 Mid deck Locker Fire Port Extention Hose Mission Kit MVO653A			X	05-25-623652-001D	6/01/01S	• Provides for better fit to locker

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18755 External Airlock Bag-Strap Velcro Mission Kit MVO849A			X	04-25-669-002025-001C	6/01/01S	
MCR 18872 Edge Lit Panel Installation				N/A		• Cert not required per SSM-mod doesn't roll dash number at assembly level

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

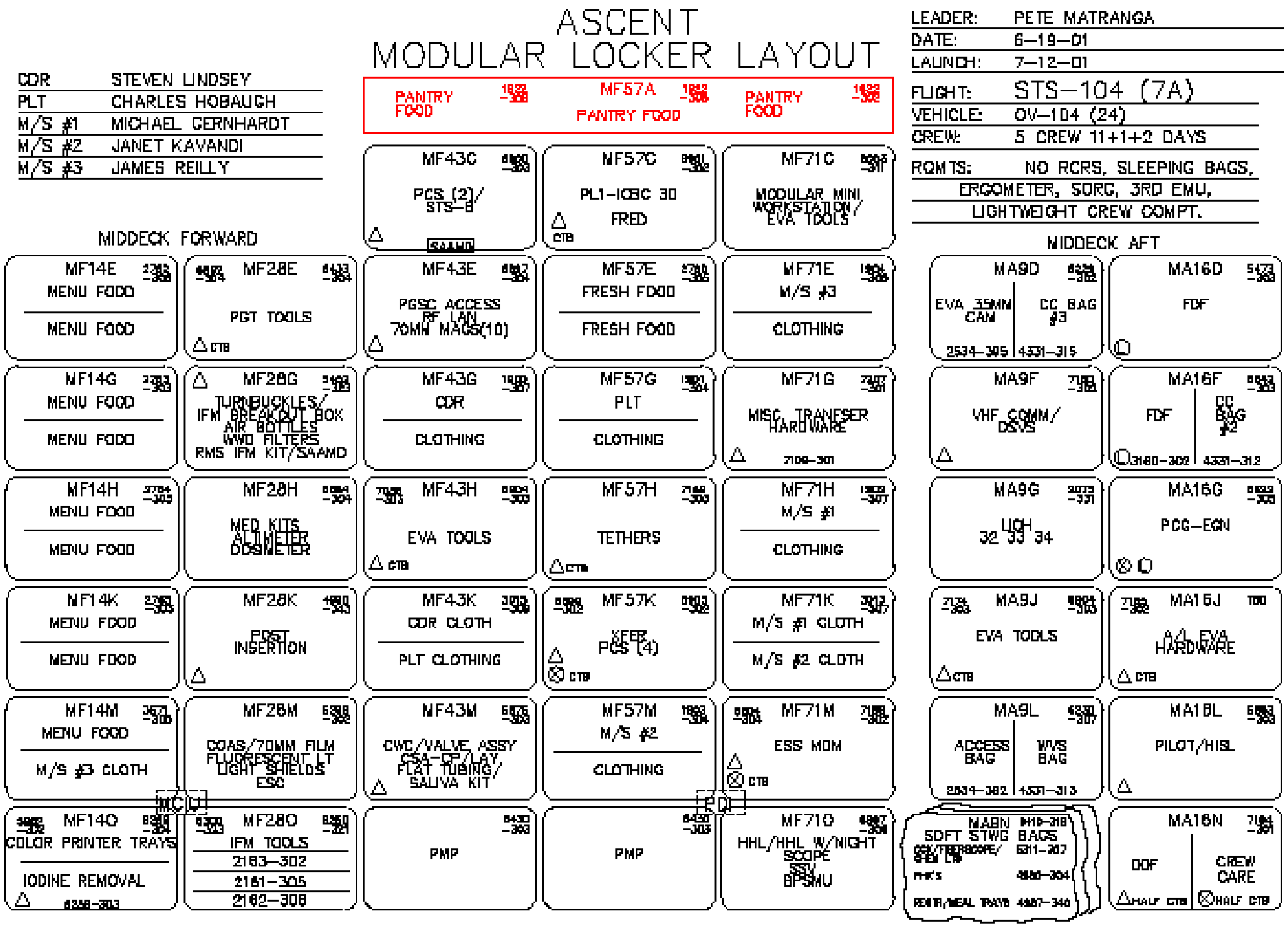
Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 18755 Locker Activation Mod Mission Kit MVO602A				02-25-660800-001B	6/01/01S	• Latch changed to double acting latch so will not inadvertently unlatch
MCR 19112 WVS Clean-Up				N/A		• Shaves ground straps to get rid of sharp edges • Adds load plugs at Sill interface for Antenna 6 which was removed for this flight
MCR 19376 Milson Fastener Redesign Mission Kit MVO602A				02-25-000907-001A 16-25-661602-001O 05-25-661612-001F 09-25-660511-001H	6/01/01S 6/01/01S 6/01/01S 6/01/01S	• MA9N Bags/Frame • Mid-deck Modular Stow Kit • Panels-Avionics Bay C/O • Thermal Debris Panels

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01



Δ - Lightweight Locker with Modified Milson Sleeve Bolt

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Corrective Action Mandatory

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			

MCR 19381
Lightweight Mission Specialist Seat Lever Relocation
 	
Mission Kit MVO226A
		X	X	CAR 04-25-39126815-301D	1/22/01A	• Modified the lightweight mission specialist seats by relocating the seat back angle adjustment lever from the right hand side aft to the right hand side forward.
						  • Forward lever location is easier to reach, allowing more force to be applied
						  • Eliminates the difficulty some crew members had changing utilizing the adjustment lever to change the seat back angle from launch to entry position after main engine cut-off
						• To accommodate this change, the inertia reel adjustment lever was relocated from the right hand side forward position to the left and side forward position
						• Makes the mission specialist seat lever configurations common to the pilot and commander seats

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Corrective Action Mandatory

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19494 Drag Chute Reefing Line	X			08-44-621-0076J	5/8/01A	
MCR 19527 Verification and Installation of Aft Fuselage Convoluted Tubing Through Harness Support Clamps				N/A *	N/A	• During OMM inspection of OV-102 aft fuselage wiring, insulation damage and exposed conductors adjacent to clamps was found in cases where the convoluted tubing ended at the clamp point • The damage appeared to be a result of convoluted tubing being pressed into the harnesses due to personnel or equipment impact • Engineering was released to require all aft fuselage convoluted tubing harness protection to be installed continuously, through the harness clamps

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Corrective Action Optional / Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			

MCR 19535
Heat Shrink Tubing to Protect Forward Separation Pyro Harnesses
 	
Mission Kit MVO401A
				N/A *	N/A	• One of the findings from the fleet wiring investigation was that harnesses routed to various pyrotechnic devices in the orbiter are frequently handled and subject to excessive flexing, resulting in possible damage.
						• Corrective action identified to preclude damage is to add heat shrink tubing -
						  • Along the harness length to limit flexing and to protect the harness from damage
						  • An additional, localized overwrap sleeve, at the connector strain relief tang, to minimize local stress concentration
						• Harness inspection will be performed prior to application of the heat shrink tubing
						• During this processing flow, the Aft Fuselage Orbiter/ET pyro harnesses were modified

CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

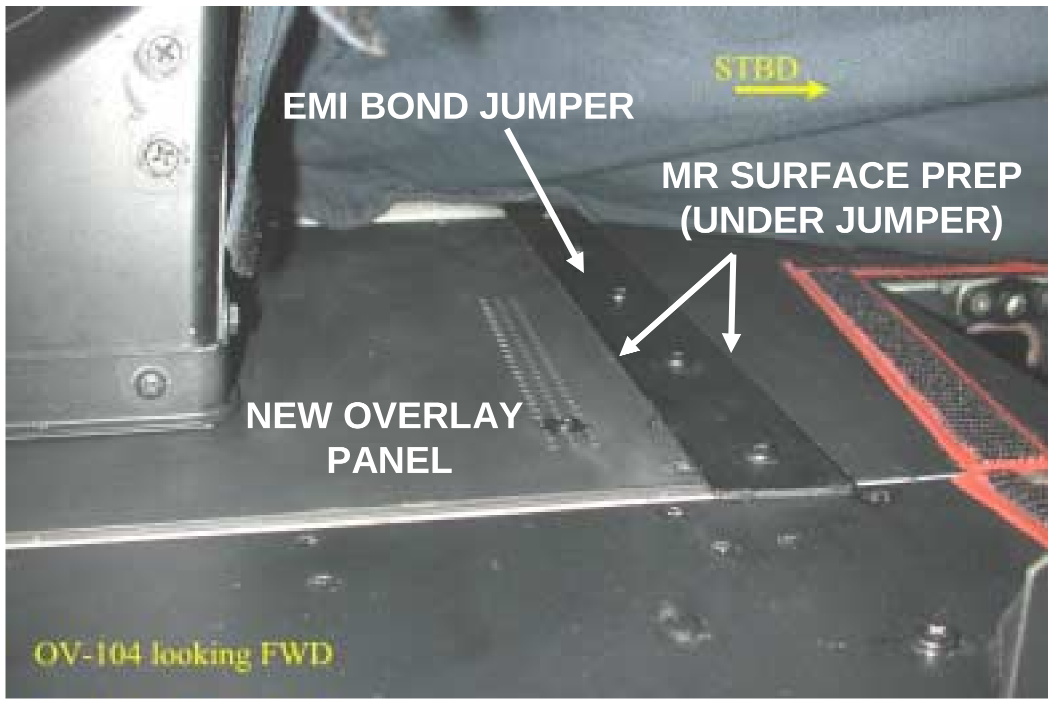
Corrective Action Optional / Process Improvement

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 19605 ODS Centerline Camera Harness Modification				N/A *	N/A	• STS-106 primary ODS centerline camera harness failure was found to be caused by a wire failure near one of three splice locations • The failure was attributed to the fact that the harness is flexed during handling, stowage and on-orbit installation, which causes stress at the splice locations • The failure was also partly attributed to splice over-crimp • Splices utilized to reduce voltage drop • Harness modification relocates the three harness splices to be contained within the backshells, protected from flexure induced damage

CONFIGURATION CHANGES AND CERTIFICATION STATUS	Presenter:
	Organization/Date: Orbiter/06-28-01

MCR 23021 MEDS Panels

- MR required to resolve non-compliance with lightning protection surface preparation



CONFIGURATION CHANGES AND CERTIFICATION STATUS

Presenter:

Organization/Date:
Orbiter/06-28-01

OV-104 STS-104 Modifications and Certification

Current Mission Requirements

MCR/Modification	Certification Method			Certification Approval Request No.	Approval Date	Remarks
	Test	Analysis	Similarity			
MCR 23021 MEDS Cooling Vent Phase I				N/A		• Phase I installs a new closeout overlay on the Forward upper console
MCR 23033 ISS WCS	X	X		04-23-623000-001E	5/8/01A	• Approval for ISS WCS Installation
		X		143-04-331002H	6/01/01S	• Transmittal of HB stress report on crew module structure

	Presenter:
	Organization/Date: Orbiter/06-28-01

MISSION KITS BACKUP

ORBITER PROVIDED MISSION KITS	Presenter:
	Organization/Date: Orbiter/06-28-01

Orbiter Provided Mission Kit Changes:

- MV0573A Aft Ballast Fuselage Shim Installation
- MV0828A Condensate Modification adding closeout assembly and bracket
- MV0828A ODS Centerline Camera Harness Redesign
- MV0226A Mission Specialist LW Seat Back Mechanisms
- MV0433A ISS WCS Installation
- MV0849A STS-98 LW & HW TSA Mission Unique Cushion Configuration
- MV0874A Wireless Video Mission Kit
  - Removal of S-Band Antenna #6

	Presenter:
	Organization/Date: Orbiter/06-28-01

SPECIAL TOPICS BACKUP

	Presenter:
	Organization/Date: Orbiter/06-28-01

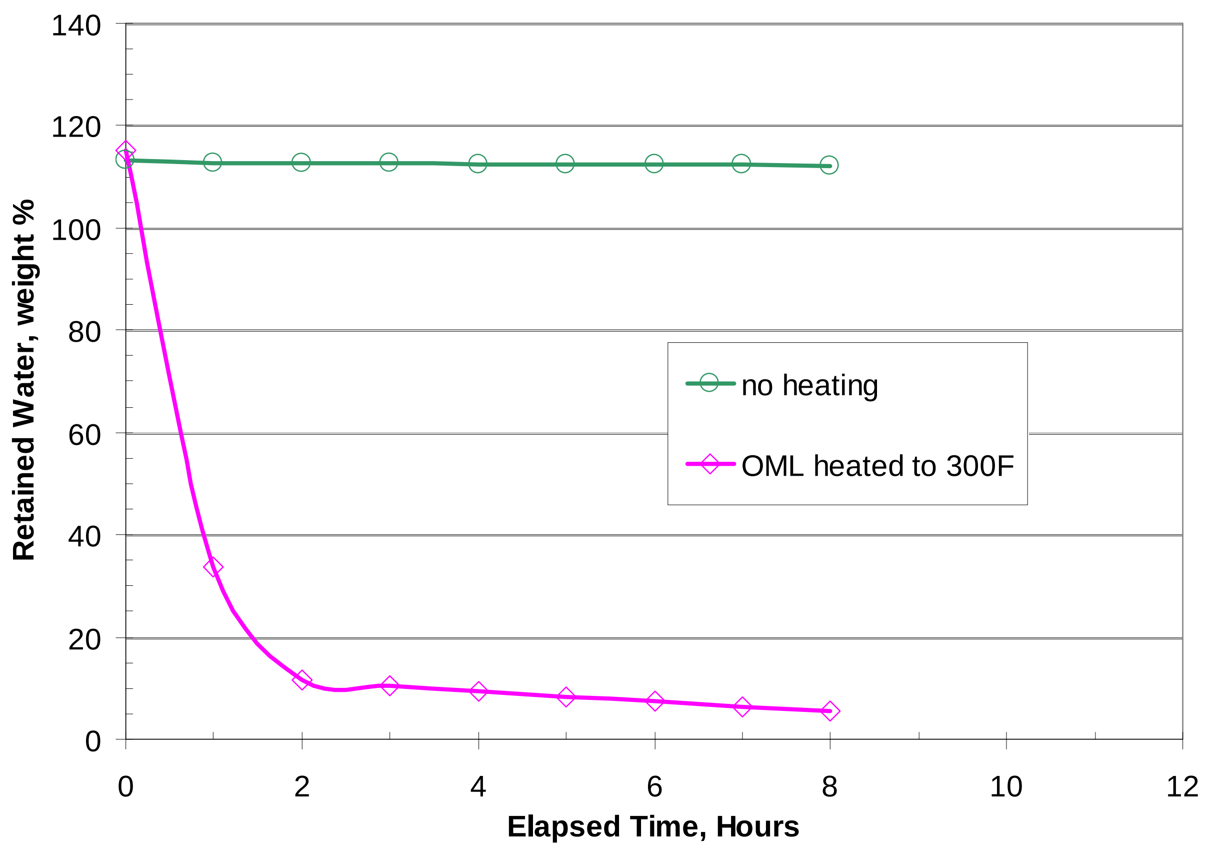
OV-104 WET TILES BACKUP

OV-104 WET TILES

Presenter:

Organization/Date:
Orbiter/06-28-01

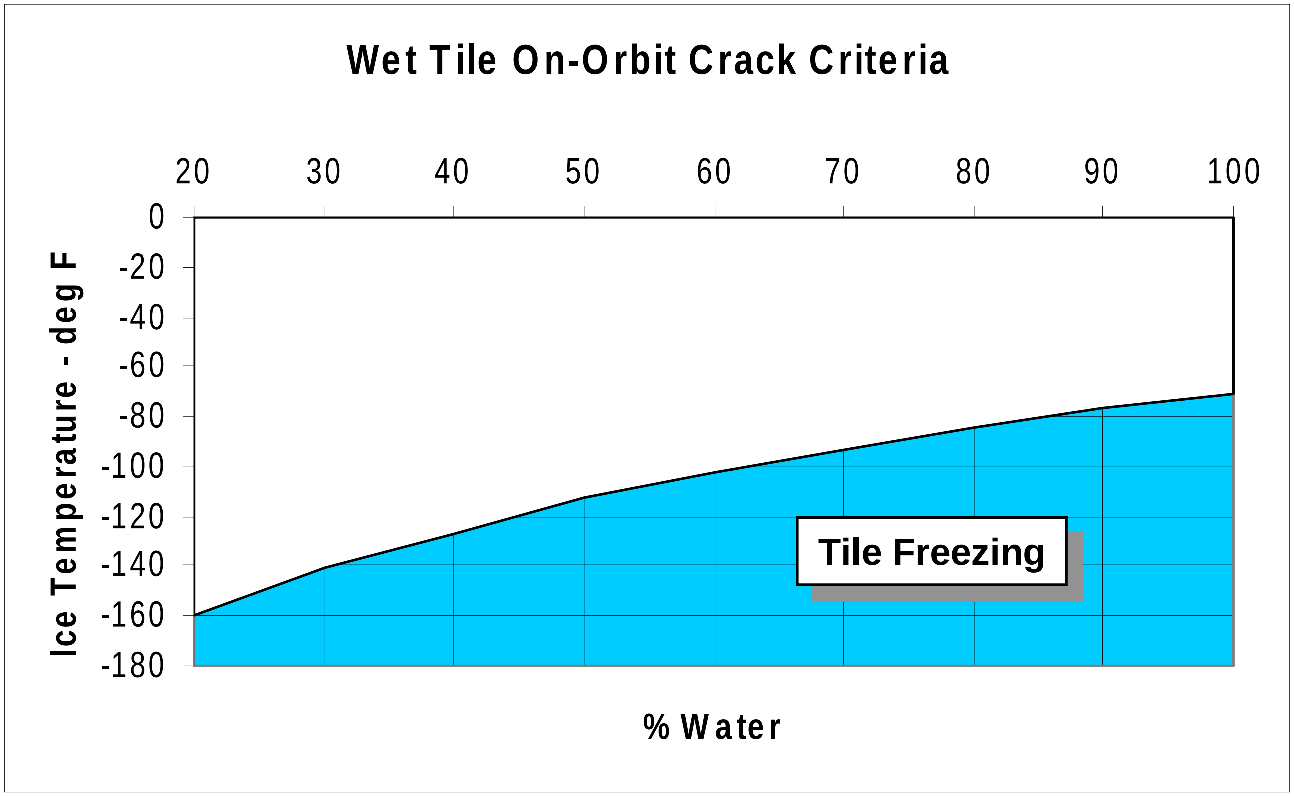
BOEING TILE DRYING LAB TEST RESULTS



OV-104 WET TILES

Presenter:
Organization/Date: Orbiter/06-28-01

1985 NASA TILE TEST DATA



SPECIAL TOPIC BACKUP

Presenter:

Organization/Date:
Orbiter/6-28-01

MPS/PRSD CRYO SKID TEST STAND OIL CONTAMINATION

BACKUP

SPECIAL TOPIC BACKUP

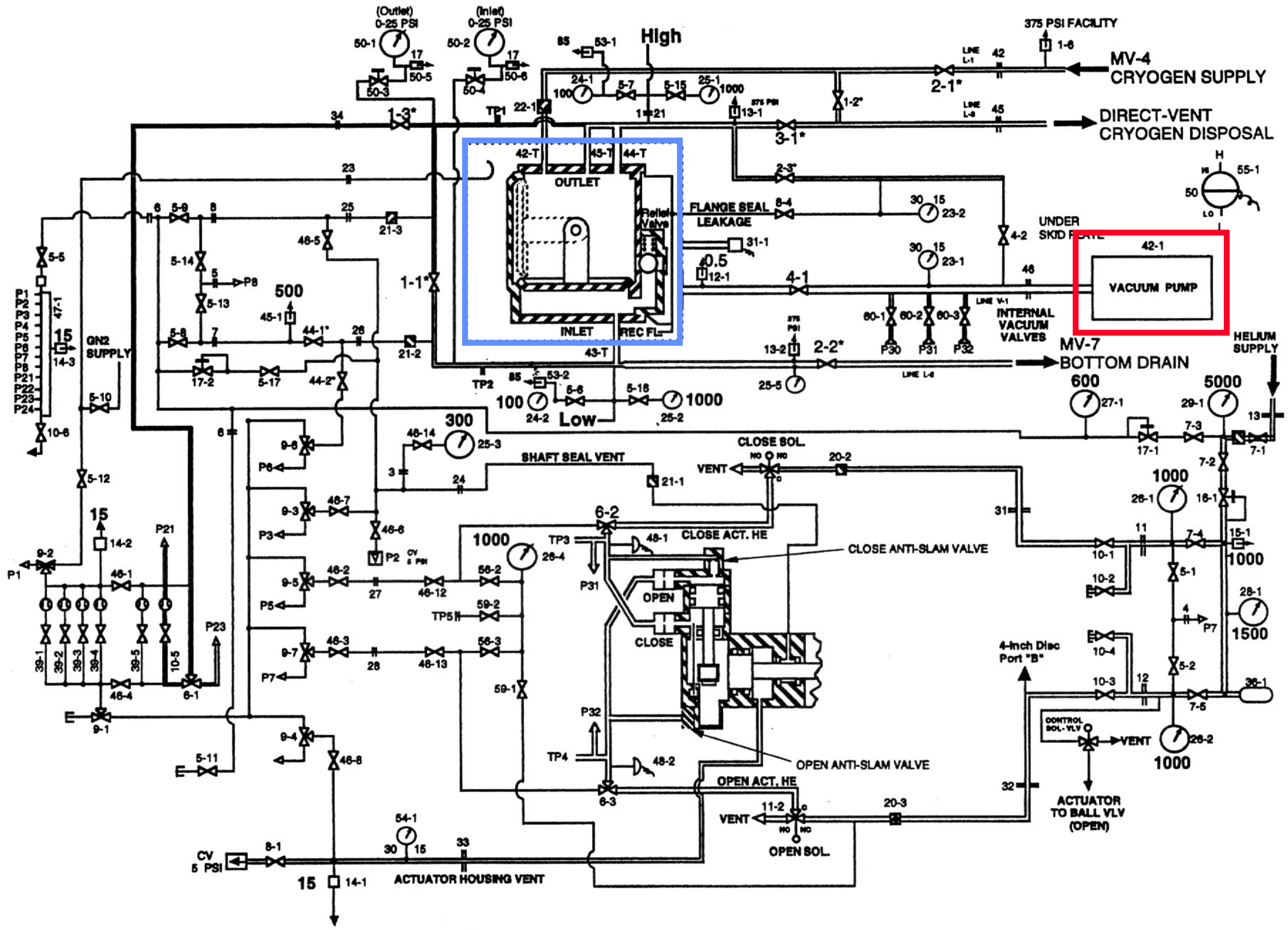
Presenter:

Organization/Date:
Orbiter/6-28-01

INVESTIGATION PLAN

1. DETERMINE PROPERTIES OF CONTAMINANT	COMPLETE
2. IDENTIFY POTENTIALLY AFFECTED HARDWARE	COMPLETE
3. DETERMINE MAX LEVEL OF CONTAMINATION	-
a. SAMPLE EXPOSED HARDWARE	COMPLETE
b. PERFORM SKID TEST	-
i. CHARACTERIZE EFFECT ON CLEAN HARDWARE	COMPLETE
ii. CHARACTERIZE EFFECTS OF VACUUM BURP	COMPLETE
iii. CHARACTERIZE CONTAMINATION VS. DISTANCE	COMPLETE
iv. CHARACTERIZE TIME ACCUMULATION	COMPLETE
4. EVALUATE EFFECTS OF LN2 FLOW	-
a. DETERMINE OIL MIGRATION	COMPLETE
b. CHARACTERIZE FLUSH REMOVAL EFFECT	COMPLETE
5. DETERMINE IGNITION THRESHOLD	-
a. DEVELOP TEST FORCE REQUIREMENT BASED ON MPS/PRSD APPLICATIONS	COMPLETE
b. IMPACT TEST TO DETERMINE CONCENTRATION VS. IGNITION	COMPLETE
6. IDENTIFY AND DETERMINE PEDIGREE OF AFFECTED TEST HARDWARE	-
a. CRYO SKID TEST STAND HISTORY	COMPLETE
b. OTHER VACUUM PUMP HARDWARE	COMPLETE
7. ASSESS TEST EQUIPMENT	
8. DEVELOP CLEANING PROCEDURES	

NSLD CRYO SKID TEST STAND SCHEMATIC

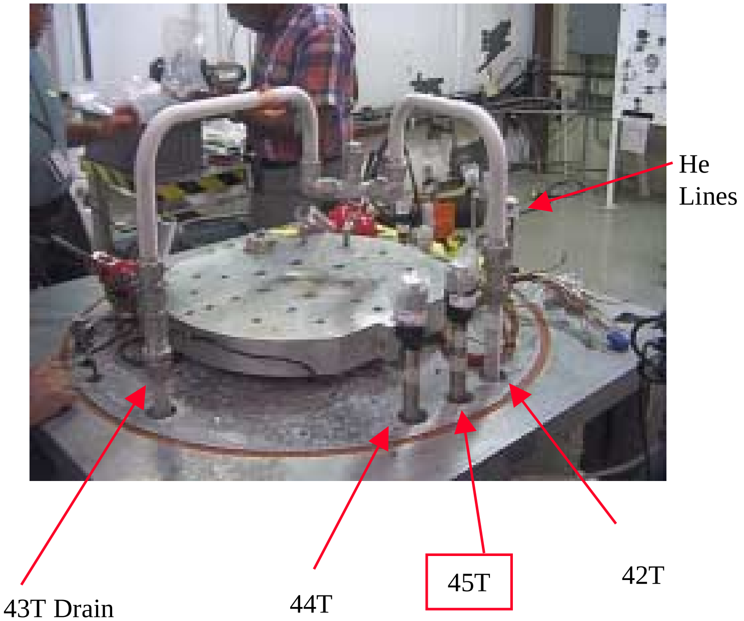


NSLD Flush Test:

1. Use 1 inch tee's (KC127 or similar) with elbows attached to each end
2. Contaminate fittings as follows:
   2 each 1 mg, 2 each 5 mg, 1 each 10 mg, 2 each 20 mg, 1 each 100 mg
3. Using flex lines, attach fitting to inlet (42T) to drain (43T)
4. Configure stand to run full flow of LN2 through fitting for 5 min.
5. Remove fitting from stand and route to Wiltech for rinse analysis. Use 500 ml for flush. Report NVR using a 50 ml sample. Return NVR pan, filter patch, and NVR fluid to M&P for further analysis.
6. M&P to determine oil mg in Freon 113 sample.

SPECIAL TOPIC BACKUP	Presenter: Organization/Date: Orbiter/6-28-01

NSLD FLUSH TEST SETUP



SPECIAL TOPIC BACKUP

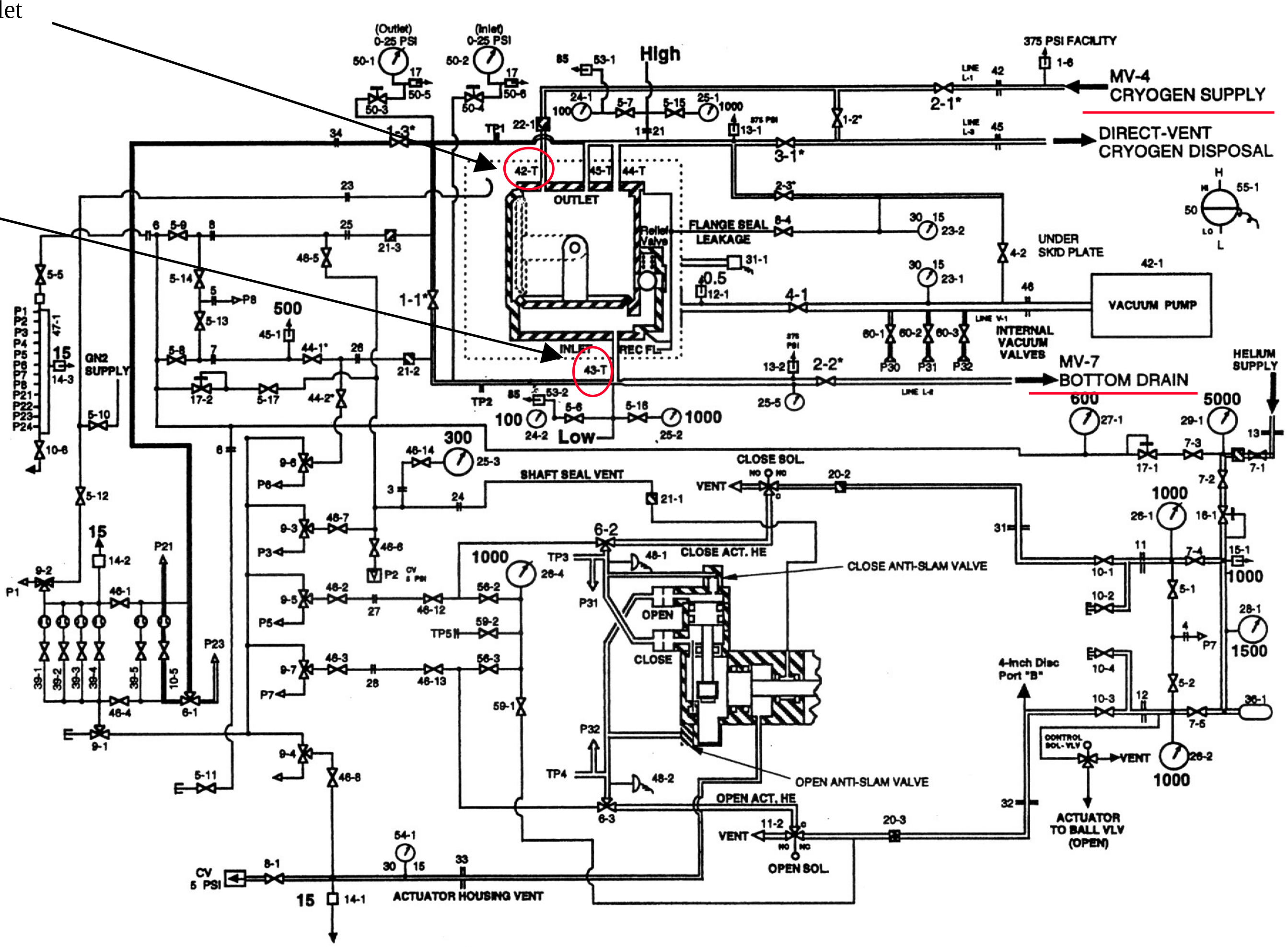
Presenter:

Organization/Date:
Orbiter/6-28-01

NSLD FLUSH TEST SETUP

42T inlet

43 T Drain



SPECIAL TOPIC BACKUP	Presenter: Organization/Date: Orbiter/6-28-01

NSLD Clean Hardware Test:

NSLD testing is being performed on skid to further characterize contamination process

Purpose:

This test is to determine the amount of oil deposited in clean hardware from the test stand. Since flight hardware in question is two configurations (with and with out filters) , test article configuration will use filters

It is expected that the oil during cryogenic flow may be deposited as a particle in the filter.

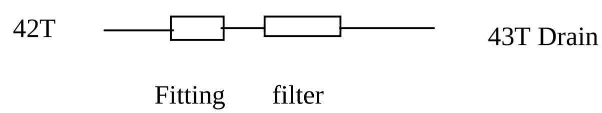
Part 1 is to determine level without use of vacuum pump.

Results: No oil found by IR analysis

NSLD Clean Hardware Test Procedure:

1. Obtain clean (Level 100A) 10 micron wire mesh filter and 1 inch fitting (similar to KC 127). For 5 test articles.
2. Maintain cleanliness of test articles per MA0110-311
3. Mate fitting to filter so it can be mounted to test stand with flow from inlet to fitting to filter to drain.
4. Use same test lines as Test 1. Do not switch inlet and outlet lines.
5. Configure stand to run full flow of LN_2 through fitting for 5 min.
6. Remove fitting from stand. Disassemble fitting from filter and route to Wiltech for rinse analysis. Use 500 ml for flush for fitting. Use 500 ml back flush for filter. Report NVR using a 50 ml sample. Return NVR pan, filter patch, and NVR fluid to M&P for further analysis.
7. M&P to determine oil mg in Freon 113 sample.

NSLD Clean Hardware Test Setup:



SPECIAL TOPIC BACKUP	Presenter: Organization/Date: Orbiter/6-28-01

NSLD contamination vs. distance test:

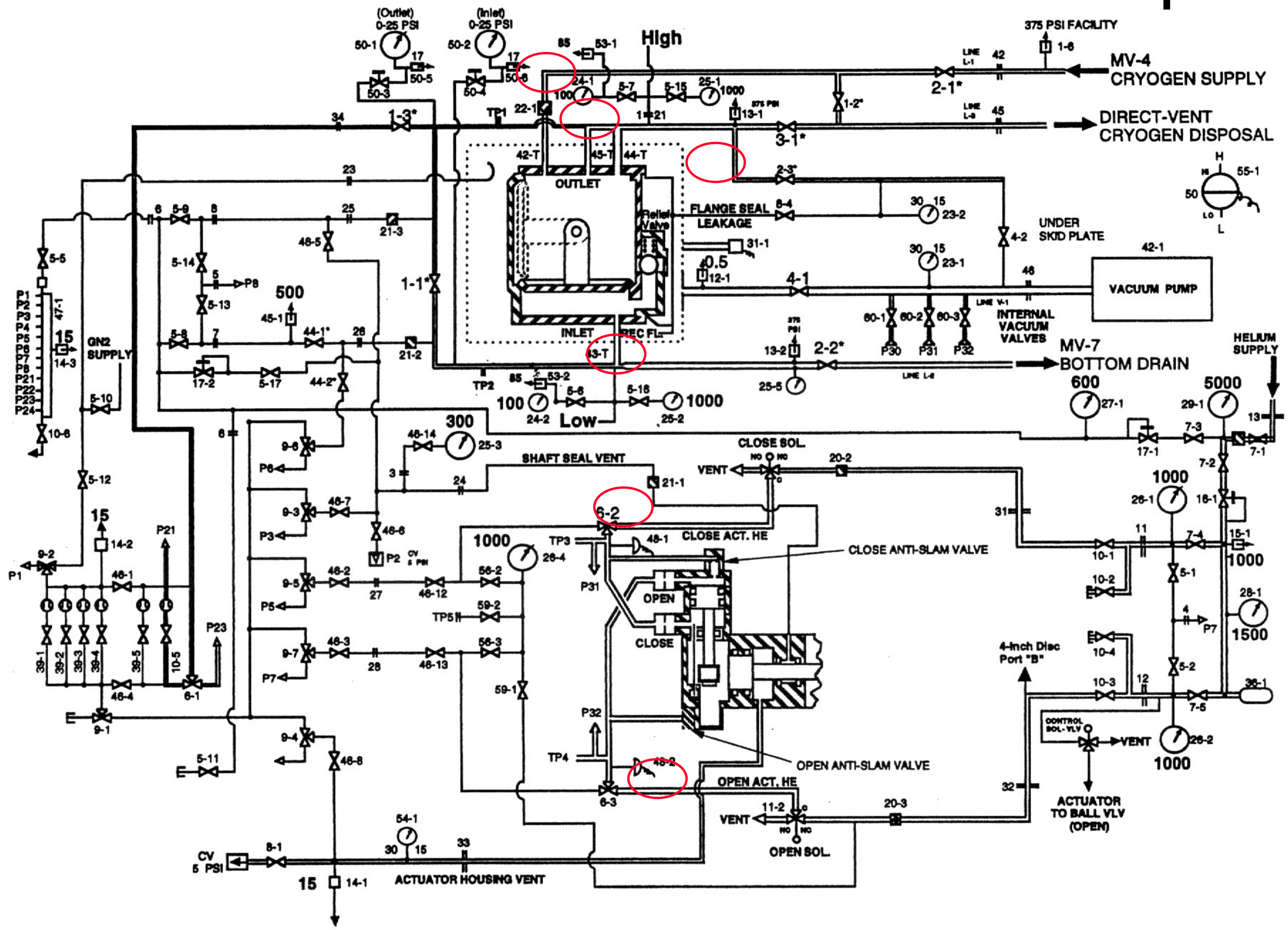
- Purpose: This test is to determine how oil concentrations vary with distance from vacuum pump.
- Oil is at known levels downstream of Valve 4-2 (original site wet with oil) and at test flange interface with flight hardware. This test will look at in between lines.
- Procedure:
  1. Pull lines by vacuum line (valve 2-3) LN2 inlet, LN2 drain, He open, He closed lines.
  2. Perform rinse analysis to determine amount of oil, Clean to 100A
  3. Run vacuum burp test
  4. Pull lines by vacuum line (valve 2-3) LN2 inlet, LN2 drain, He open, He closed lines.
  5. Perform rinse analysis to determine amount of oil

NSLD contamination vs. distance test:

- **Results:**
  - Level of contamination steadily decreases as distance from pump increases
    - No oil present in straight lines
    - Collection is in convoluted flexlines and test flanges
    - convolutes are prone to entrap particulates
    - Test flange configuration lends to evaporative deposit during LN2 fill & dispose sequences

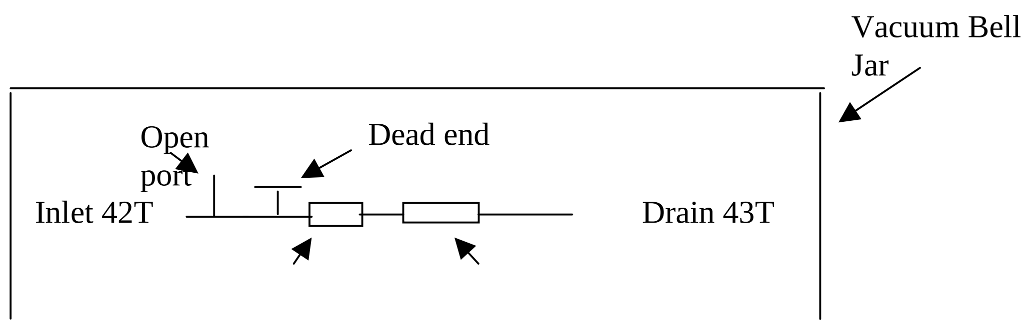
SPECIAL TOPIC BACKUP	Presenter: ____________ Organization/Date: Orbiter/6-28-01

NSLD contamination vs. distance test setup



NSLD vacuum burp test:

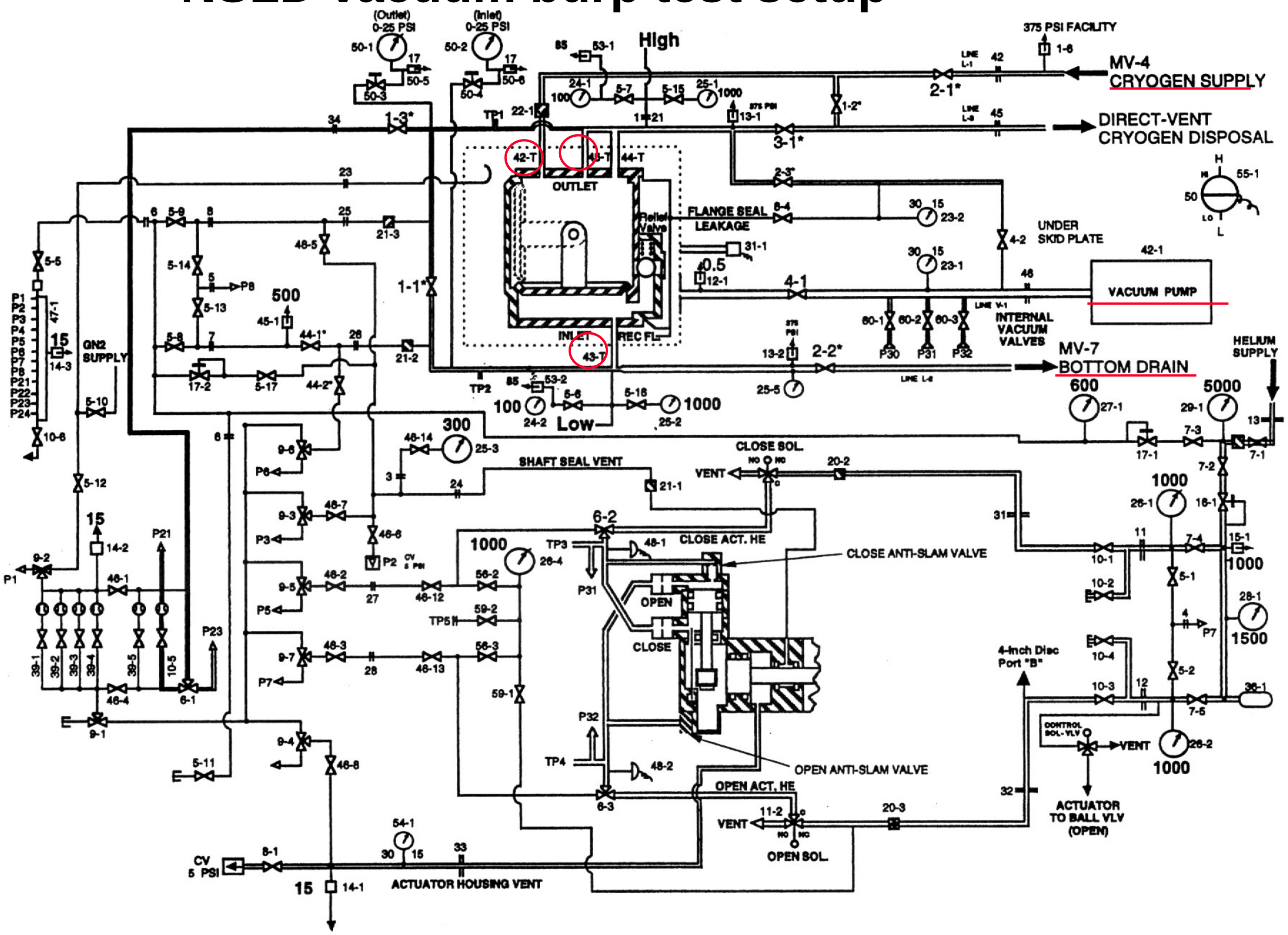
- NSLD testing is being performed on skid to further characterize contamination process
- Part 2 is to determine level after use of vacuum pump.
- Results:
  - No vacuum oil was deposited on clean hardware
  - Singular event deposits evaluated by turning off pump power to aid oil back diffusion
  - Singular event would be associated with processing of 12” pre-valve (11/92, 3/99, 6/99, 3/01)
    - Only time vacuum system is open to LN2 system



NSLD vacuum burp test procedure:

1) Obtain clean (Level 100A) wire mesh filter and 1 inch fitting (similar to KC 127). For 7 test articles.
2) Maintain cleanliness of test articles per MA0110-311
3) Mate fitting to filter so it can be mounted to test stand with flow from inlet to fitting to filter to drain
4) Use same test lines as Test 1. Do not switch inlet and outlet lines.
5) First two test articles – turn on vacuum pump to evacuate test article for 5 mins. At end of 5 mins. turn off pump leaving vacuum on test article. Repeat this 5 times.
6) Remove test article from stand. Disassemble fitting from filter and route to Wiltech for rinse analysis. Use 500 ml for flush for fitting. Use 500 ml back flush for filter. Report NVR using a 50 ml sample. Return NVR pan, filter patch, and NVR fluid to M&P for further analysis. Do not reclean fitting or filter element.
7) M&P to determine oil mg in Freon 113 sample.
8) For five remaining test articles – turn on vacuum pump to evacuate test article for 5 mins. At end of 5 mins. turn off pump leaving vacuum on test article. Repeat this 5 times
9) Configure stand to run full flow of LN2 through fitting for 5 min.
10) Remove fitting from stand. Disassemble fitting from filter and route to Wiltech for rinse analysis. Use 500 ml for flush for fitting. Use 500 ml back flush for filter. Report NVR using a 50 ml sample. Return NVR pan, filter patch, and NVR fluid to M&P for further analysis. Do not reclean fitting or filter element.
11) M&P to determine oil mg in Freon 113 sample.

NSLD vacuum burp test setup



SPECIAL TOPIC BACKUP	Presenter: Organization/Date: Orbiter/6-28-01

NSLD time accumulation test procedure:

1) Obtain clean (Level 100A) 10 micron wire mesh filter and 1 inch fitting (similar to KC 127). For 5 test articles.
2) Maintain cleanliness of test articles per MA0110-311
3) Mate fitting to filter so it can be mounted to test stand with flow from inlet to fitting to filter to drain.
4) Use same test lines as Test 1. Do not switch inlet and outlet lines.
5) Configure stand to run full flow of LN2 through fitting for 10 min each for first two fiitings. 20 min. each for last three.
6) Remove fitting from stand. Disassemble fitting from filter and route to Wiltech for rinse analysis. Use 500 ml for flush for fitting. Use 500 ml back flush for filter. Report NVR using a 50 ml sample. Return NVR pan, filter patch, and NVR fluid to M&P for further analysis. Do not reclean fitting or filter element.
7) M&P to determine oil mg in Freon 113 sample.

SPECIAL TOPIC BACKUP

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NSLD time accumulation test setup:

Refer to “Burp” test schematic

NSLD time accumulation results:

- Expected result: No oil present in test articles
- Articles were flow through specimens
    - LN2 cleaning effect supported lack of oil presence
- Oil as a particulate was not trapped in filter

SPECIAL TOPIC BACKUP

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Actions In Work:

6.)Determine Root Cause

- Vacuum pump oil back streamed into the test skid
  - Pump is a 2- stage rotary vane
- Test to determine seal integrity and anti back diffusion are in work

7) Assess other vacuum applications

- All systems identified- Complete
  - No other exposes LOX hardware to vacuum oil
- Determine if other is at risk due to pump failure - In work

8) Develop cleaning procedure - In Work

- Cleaning vendor contacted to assess task

SPECIAL TOPIC BACKUP

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Issue

- Hydrocarbon contamination introduced to SSME LO2 system

Background

- OV-104 MPS LO2 Fill and Drain valves possibly contaminated with vacuum pump oil from refurbishment facility (NSLD)
  - Up to 0.0175 Grams introduced to Orbiter System
    - 3 flights and 6 tankings since contamination introduced
  - Under cryogenic conditions, oil solidifies and migrates
- Oil could reach SSME during ascent
  - Most likely split among 3 engines
  - Small particles
    - 1000 micron pre-valve screen
    - 100 micron AFV filter

Analysis

- LO2 system
  - Small quantity diluted by LO2 flow, <0.00004 Lbs oil
  - Small particles insufficient to ignite in LO2 environment
    - 1000 micron
      - 0.0175 grams = 43 spheres, 1000 micron dia.
      - Spheres break up even more upon impact
- GO2 system
  - Even smaller quantity
    - 1.9 lbms/sec LO2 Vs 900 lbms/sec LO2 total flow
  - Smaller particles
    - 100 Micron Filter
  - Oil vaporizes, mixes with GO2 and combusts
    - Assumes vapor phase burning
    - Insufficient heat transfer to metal to melt

White Sands test experience

- Up to 900 mGrams/ft^2 oil in dead headed 304 Cres tube
  - Different oil, but similar
  - HEX is 316L
- Introduced GO2 at 7,500 PSI
  - HEX pressure = 4000 PSI
  - Ignition of oil contaminant by adiabatic compression heating
  - Identified threshold for ignition = 6.5 mGrams/ft^2
  - Oil burned away, no damage to metal

Conclusion

- Analysis and test indicates contamination is acceptable to SSME for flight

Special Topic Backup	Presenter:
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ALCA #3 Power Connector Lugs Backup

Special Topic Backup

Presenter:

Organization/Date:
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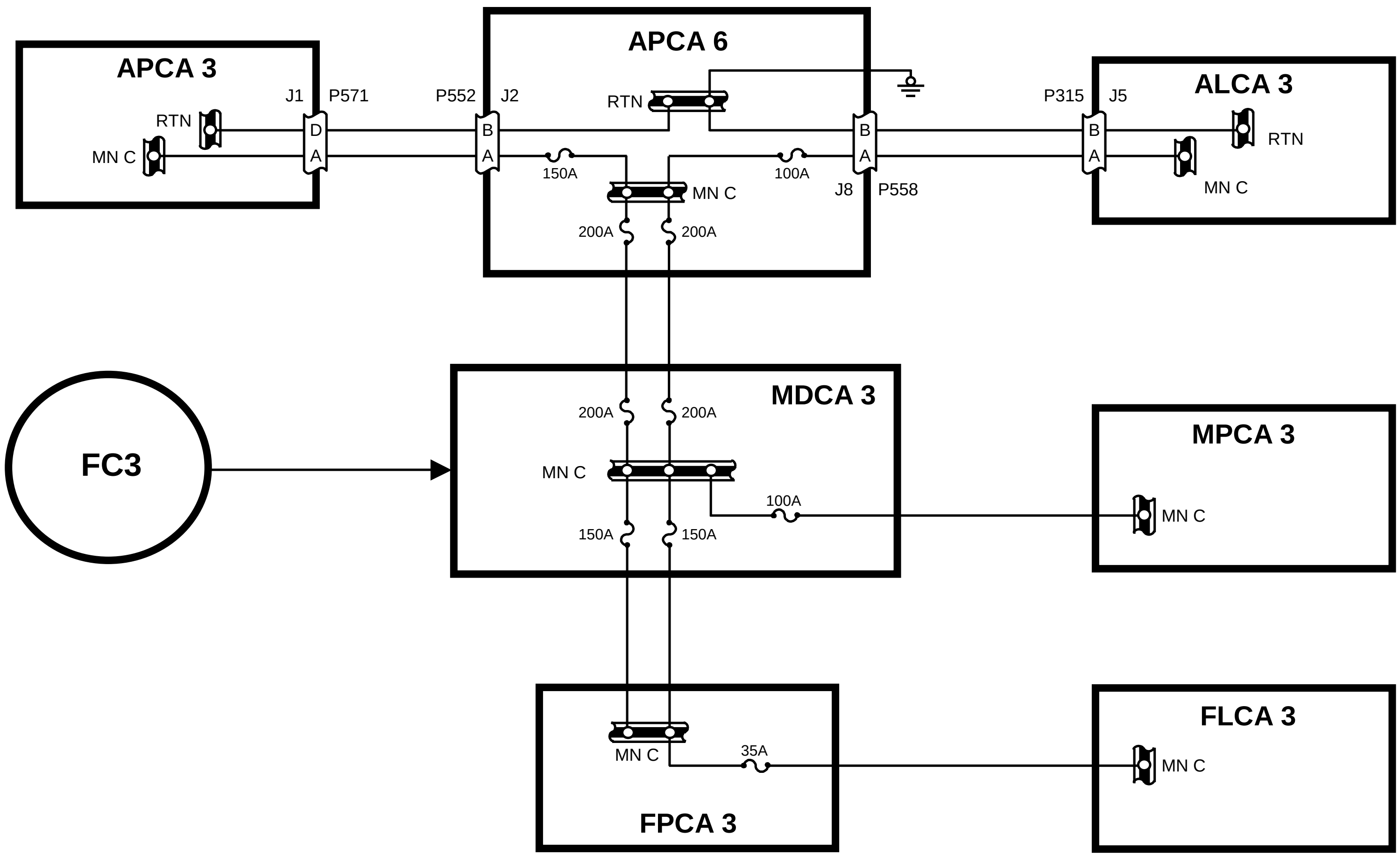
SIMPLIFIED MAIN BUS C POWER DISTRIBUTION DIAGRAM



Special Topic Backup	Presenter:
	Organization/Date: Orbiter/06-28-01

LCA SYSTEM EFFECT INVESTIGATION

MPS LCA Loss

- LH2 inboard fill & drain valve, LH2 topping valve and LH2 high point bleed on **ALCA1**
  - T-4.5 hours through T-0; ALCA1 loss results in closure of these valves ET vent becomes primary path for hydrogen boil-off, launch scrub multi-week boil-off to recover count.
  - T-0 through MECO +2 minutes; ALCA1 loss results in closure of these valves. Requires dumping propellant through RTLS dump valves. OPS 1 and OPS 3 transition effected.
- LO2 inboard fill & drain valve, LH2 manifold repress solenoid, and LH2 outboard fill & drain valve on **ALCA2**
  - LO2 fill and drain valve causes launch scrub, If LCA failure after 4m 55s then drain LO2 through SSME overboard bleed
  - LH2 manifold repress valve failed off; results in flammable mixture in LH2 manifold in RTLS and TAL aborts
  - LH2 outboard fill and drain valve effects same as inboard valves as described in ALCA1 loss

Special Topic Backup

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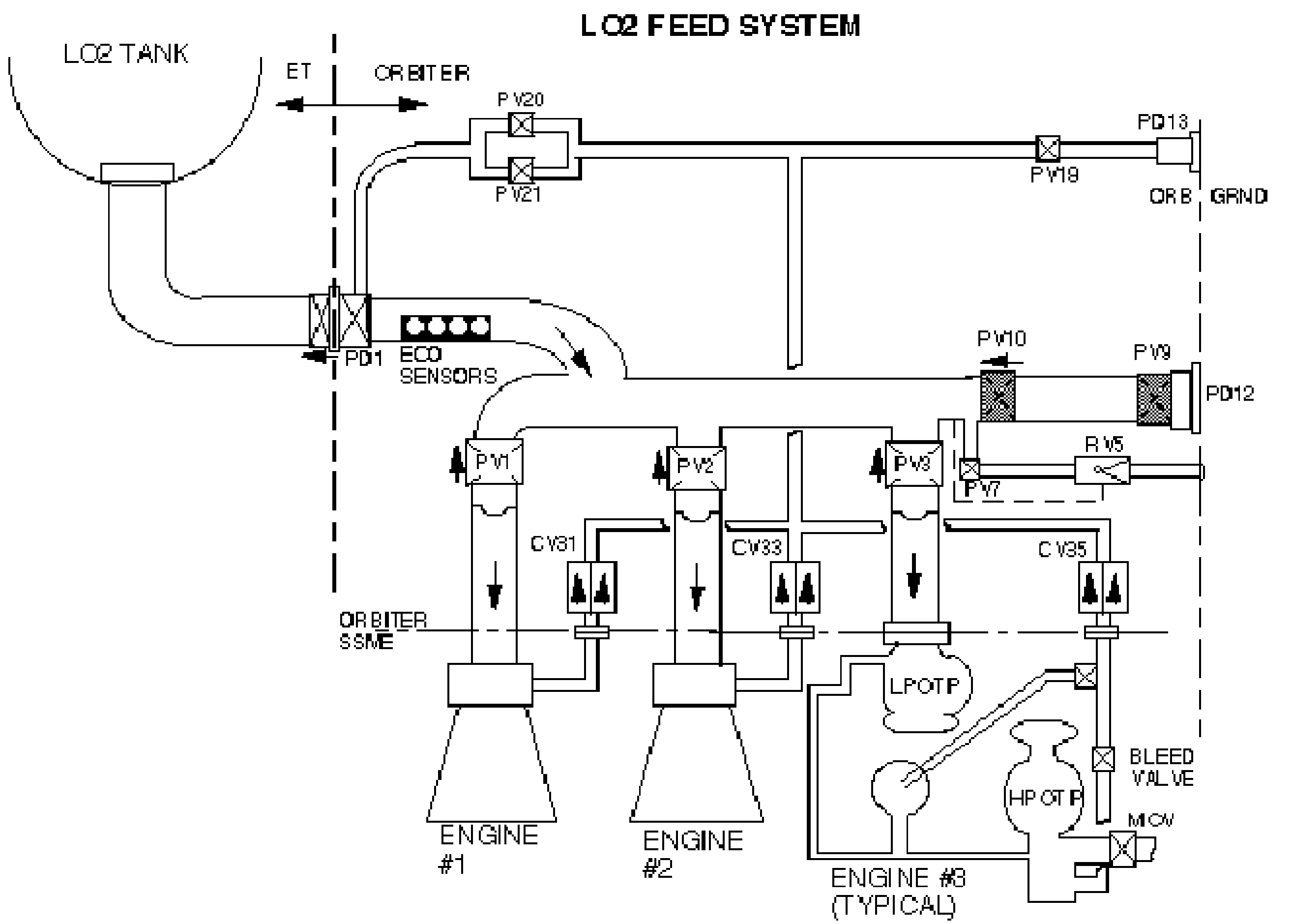

Special Topic Backup

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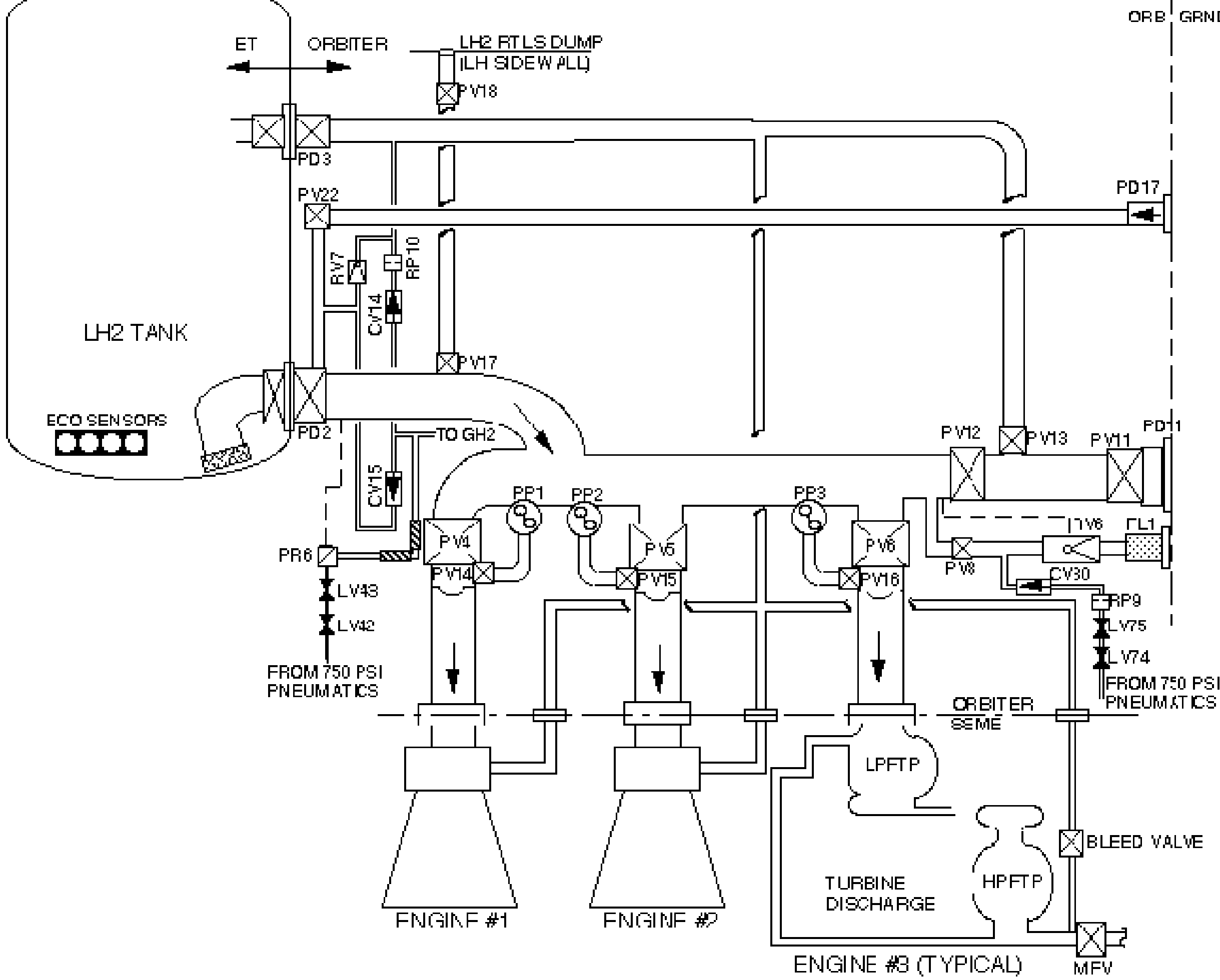
LH2 FEED SYSTEM



Special Topic Backup

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LCA SYSTEM EFFECT INVESTIGATION

RCS LCA Loss

- Loss of manifold 5 thruster heaters
  - Normally fire thrusters to maintain temperatures
  - Cold temperatures result in leakage
- Loss of Manifold 3, 4 & 5 isolation
  - If temperature of thrusters create leakage, manifold isolation is not possible
- Manifold 5 problems may not be manageable during docked operations

Special Topic Backup

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Organization/Date:
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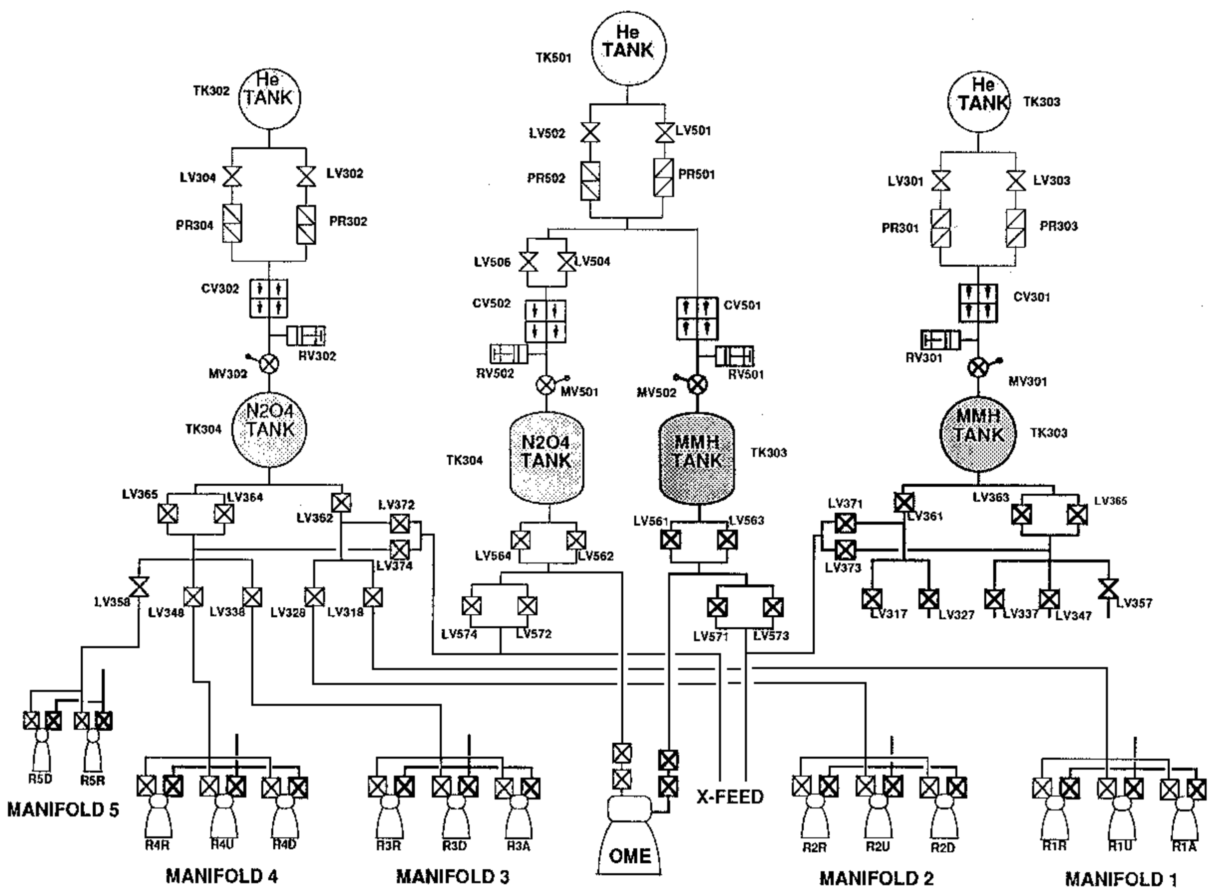
AFT PROPULSION SYSTEM - RIGHT SIDE



OV-104 WET TILES	Presenter:
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ARRAY BAKING SETUP

OV-104 WET TILES	Presenter:
	Organization/Date: Orbiter/06-28-01

CONTINUITY TESTER